Heat Transfer Mechanisms for Flow Boiling in Microgravity using Fluorescing Materials as Temperature Sensors

Completed Technology Project (2016 - 2020)

Project Introduction

I propose an experiment to study two-phase flow boiling in microgravity. Obtaining a fundamental understanding of the nature of flow boiling fluid mechanics and heat transfer in space environments will allow more compact and efficient heat exchangers to be used in space. The experiment will be conducted using high-speed CCD cameras to record HFE 7100 flowing through a transparent sapphire tube test section. The inner wall of the tube will be lined with a transparent conducting polymer film that can be electrically heated. Quantum dots will be dispersed along the bottom half of the polymer film. Quantum dots fluoresce when excited with blue or UV light, and the intensity of their emission decreases with increasing temperature. The goal of this experiment is to track the intensity changes of the quantum dots with the CCD cameras in order to obtain a temperature distribution along the inner wall of the test section while the polymer film is heating the fluid. This temperature data can be used to obtain values for local heat transfer for the test section. Ground-based experiments will be tested first in order to confirm the validity of this method with respect to current flow-boiling correlations. The experiment apparatus will be optimized by mass and volume in order to increase feasibility of being able to run on either a parabolic flight or the International Space Station. Performing the temperature acquisition in either of these environments will allow correlations to be made for flow-boiling in microgravity environments. The resulting data from this experiment will help develop more accurate correlations for space-based heat exchangers, allowing spacecraft to distribute heat and power more consistently.

Anticipated Benefits

The resulting data from this experiment will help develop more accurate correlations for space-based heat exchangers, allowing spacecraft to distribute heat and power more consistently.

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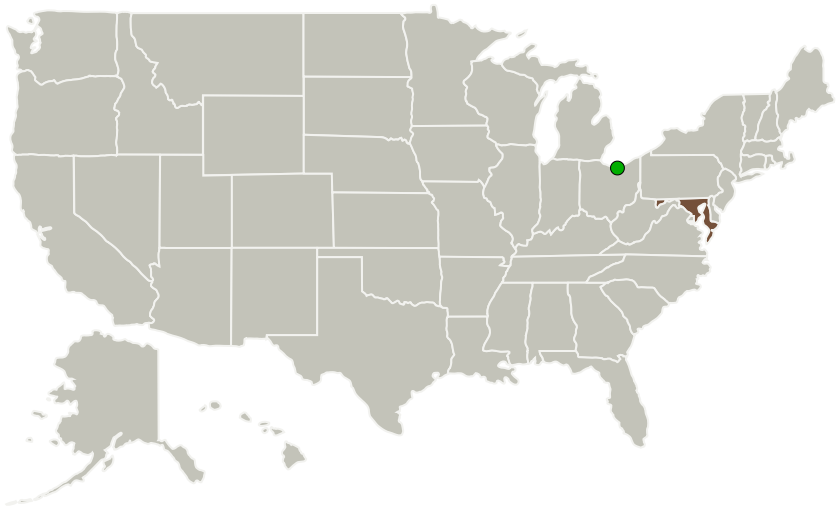
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Maryland-College Park(UMCP)	Lead Organization	Academia Asian American Native American Pacific Islander (AANAPISI)	College Park, Maryland
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations
Maryland

Project Website:

https://www.nasa.gov/strg#.VQb6T0jJzyE

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Maryland-College Park (UMCP)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Junghoon Kim

Co-Investigator:

Caleb F Hammer

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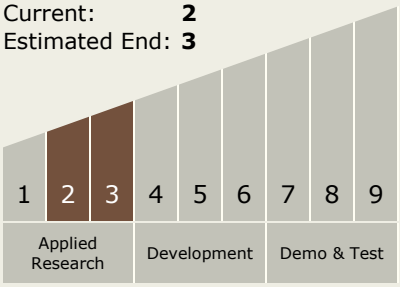
Completed Technology Project (2016 - 2020)

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.8 Measurement and Control

Target Destinations

The Sun, Earth, The Moon